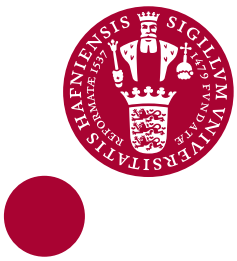

A regionalized cluster analysis of global seismic models: implications on thickness and thermochemical structure of continental lithosphere

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A regionalized cluster analysis of global seismic models: implications on thickness and thermo-chemical structure of continental lithosphere

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We apply a regionalized cluster analysis of available global shear-wave (VS) models to extract robust features of the seismic structure of continental lithosphere. In agreement with the resolution of surface waves, we find that the large-scale isotropic structure of all models (i.e. first 8 harmonic degrees) identifies uniquely the shape of seismically-fast regions in the cores of continental areas. The most uniform clusters are located in Europe, North-America and Australia. Absolute velocities differ between the models, even after removing the differences due to the starting reference models. Nevertheless, a general pattern may be identified between continents.
The mean seismic profiles beneath the East-European and Australian cratons are characterized by almost constant shear velocity, while a decrease of around 2 % between 100 and 250 km depth is observed beneath the North-American fastest cluster. In addition, several clusters are more than 1% faster than global average value at 300 km depth, indicating that the continents reach at least to this depth.
A quantitative interpretation of the absolute velocities in terms of chemical composition and thermal variations is hampered by the differences between seismic models and by the fact that the seismic profiles represent averages over large areas. To a first order, however, the seismic depth profiles in the seismically most uniform continental regions are consistent with the expected thermal structure. In addition, systematic variations in the gradients with depth and differences between “cratonic” regions, indicates the presence of large-scale (average) compositional variations within the lithosphere.